



***Guidelines For Developing A Task-Oriented  
Work Breakdown Structure (WBS)***

**BTeV Document** (number to be assigned)

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## How To Access This Document

- Access the first BTeV internal web page
- Click on “BTeV WBS Level 2 Task Management Plans, Requirements, and Cost and Schedule”
- Click under WBS & WBS Dictionaries on “Instructions & Templates”

## Revision History

- **March 3, 2001:** Removed ‘DRAFT’ from title page; modified example of Section 5 to incorporate BMM requirements into Level 2 Task’s *Requirements* document; changed some reviews and milestones from Level 2 to Level 3; added Section 6

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# 1 Introduction

This document is intended to aid the user in developing a task-oriented Work Breakdown Structure (WBS) for the work they will be doing on the overall BTeV project. The sections of the document must contain the following information:

**Section 1:** Introduction to a task-oriented WBS

**Section 2:** Definition of terms then guidelines for developing a task-oriented WBS needed for all BTeV WBS Activities (work) including reviews and milestones

**Section 3:** Explanation of when WBS Activities become task-oriented (verb-based)

**Section 4:** Detailed example of a task-oriented WBS for the prototyping phase of an electronics project

**Section 5:** Details of the cost and schedule database information needed for each WBS Activity

A WBS is a list of all activities needed to complete a specific job. The WBS and its database will be used for BTeV's Baseline Review and, after approval of the Baseline Review, for monitoring the status and costs of work being done on the overall BTeV project.

The WBS used for BTeV's initial Proposal was mostly component-oriented. Many WBS Activities were lists of needed components and their material and associated personnel costs. Schedule information for planned activities and schedule relationships between different activities were not included. A task-oriented WBS does contain this information but has a different organization. For approved projects the size of BTeV, Fermilab management and the DOE require a task-oriented WBS. Technical, cost and schedule progress of work within BTeV and the overall BTeV project itself are much more easily monitored using the task-oriented WBS approach.

This document will describe the differences between a component-oriented and a task-oriented WBS and give rules and recommendations to be used when generating a task-oriented WBS. The task-oriented WBS is used by BTeV to not only plan and monitor the design and construction of the experiment but also to facilitate the accounting and reporting required by the laboratory and funding agencies.

A WBS Activity is something to do such as design a printed-circuit board, build a straw tube, *etc.* Within each WBS Activity, additional information describes that Activity. For example, the information includes the type of people needed to accomplish the work (*e.g.*, engineers, technicians and/or physicists) and the time each person will require completing the work. Examples of additional information in a WBS Activity include personnel and material costs, a contingency estimate, the WBS Activity leader, *etc.* Pointers to documents or textual information can also be included in a WBS Activity.

The example in Section 4 illustrates the level of detail that should be included in the task-oriented WBS.

This document should be used in conjunction with the document '*WBS Activity Guidelines and Recommendations*'.

## 2 Definition of Terms

Various terms such as WBS, Activities, Levels, Tasks, *etc.* will be continuously used throughout the remainder of this document. The following should help explain them:

<b>WBS</b>	Work Breakdown Structure: An organized list of jobs within an overall project such as BTeV. DOE requires a WBS and its accompanying WBS Dictionary
<b>WBS Dictionary</b>	A definition of each WBS item (job) giving enough information so a reader understands the job, who'll be doing the work, what is the scope of the work including required quantities, <i>etc.</i>
<b>WBS Activity</b>	One line (job, task, or item) in a WBS
<b>WBS Number</b>	A unique number given to each and every WBS Activity
<b>Level</b>	An indication of a WBS Activity's place in the WBS hierarchy
<b>Level N WBS Activity</b>	A WBS Activity with an N-digit WBS number
<b>Level 2 Task</b>	Name given by BTeV Management for a Level 2 (two-digit) WBS Activity
<b>Level 2 Manager</b>	Name given by BTeV Management to the person responsible for a Level 2 WBS Activity
<b>Level 3 Task</b>	Name given by BTeV Management for a Level 3 WBS Activity.
<b>Level 3 Leader</b>	Name given by BTeV Management to the person responsible for a Level 3 WBS Activity
<b>Level N Task</b>	Name given by BTeV Management for any WBS Activity below a Level 3 WBS Activity where the 'N' corresponds to the WBS Activity.
<b>Level N Leader</b>	Name given by BTeV Management to the person responsible for a Level N (Level 4 or lower-level) WBS Activity
<b>Task-Oriented WBS</b>	A WBS containing all cost and schedule information for each of its WBS Activities and one based on doing tasks (verb-based) <i>vs.</i> material goods (noun-based). DOE requires a task-oriented WBS.
<b>task</b>	A WBS Activity at a particular level of the WBS (Level 2 or lower)
<b>subtask(s)</b>	WBS Activity(s) that are under (at a lower level of) a task

## 3 Guidelines For Generating A Task-Oriented WBS

The following subsections contain rules and recommendations for generating a task-oriented WBS.

### 3.1 *Development & Manufacturing Phases of Tasks*

Different WBS Activity tasks or subtasks must separate their prototyping or development phase from their pre-production and production or manufacturing phases. All prototyping WBS Activities within a task should be grouped together. For example, pre-production and production WBS Activities should be separated and grouped. This separation and grouping allows easier monitoring and report generation.

The task-oriented WBS example in Section 5 illustrates how all prototyping WBS Activities for a typical electronics task are grouped together.

For a specific task or subtask, group all of its prototyping WBS Activities together. Do likewise both for its pre-production and production WBS Activities.

### 3.2 *Duration of WBS Activities*

It is strongly recommended that each WBS Activity should have limited duration, usually a maximum of two to three months. Longer times complicate its monitoring and reporting. Short WBS Activity durations enable various levels of management to more closely follow the progress of tasks or subtasks (*e.g.*, management quickly becoming aware of tasks or subtasks that are behind schedule). BTeV Management will also be required to submit progress reports that detail the completion percentage on each WBS Activity. When WBS Activity times are short, reporting is very easy. If details are not submitted on each incomplete WBS Activity, problems can occur in accounting procedures required by the DOE. WBS Activities for task or subtask management are exceptions to this recommendation. In most instances, it is assumed that the expenditure of task or subtask management personnel effort is linear with time over the duration of the complete task or subtask.

To the extent practical, limit the duration of each WBS Activity to a maximum of two to three months.

### 3.3 *WBS Activities For Ordering Goods And/Or Services*

The following two subsections detail out procedures for generating WBS Activities when ordering goods and/or services that have significantly different delivery times and that require bids, respectively. Regardless of delivery times, for better task or subtask tracking it is recommended that WBS Activities for both the ordering and delivery of components be separate entries in the WBS.

When ordering goods and/or services, separate WBS Activities should be included for the ordering and for the delivery of the goods and/or services (see the Section 5 WBS example).

#### 3.3.1 *Different Delivery Times*

Section 3.2 of this document strongly recommends that WBS Activities be broken down, if practical, to those with durations not to exceed two to three months. This holds true for WBS Activities specifically for ordering goods and/or services. To the extent practical, separate WBS Activities (and subsequently separate purchase orders) should be generated when ordering goods and/or services with significantly different delivery times. Suggested classifications of delivery times are short, medium and long times. The definitions of significantly different delivery times and short, medium and long delivery times depend on the task or subtask for which they are being ordered. For example, if parts that go onto a beryllium printed circuit board all have delivery times less than a few weeks but the board itself has a delivery time of four to six months, the parts and the board should be put on separate WBS Activities and ordered on separate purchase orders from that of the beryllium printed circuit board. Doing this allows more precise task or subtask tracking and reporting, both critical to helping ensure that a task or, subtask is completed on time and within budget.

When ordering goods and/or services, items with significantly different delivery times should have separate WBS Activities and subsequently be ordered using separate purchase orders.

Refer to the task-oriented WBS example in Section 5 for an illustration of ordering and delivery of components with significantly different delivery times.

### **3.3.2 Bidding Required**

When ordering goods and/or services where bids are required, the bidding process most always requires several weeks. Following the related recommendation given in Section 3.2, a separate WBS Activity should be used for the bidding process. It follows that items requiring bids should be on separate purchase orders from those not requiring bids.

When ordering goods and/or services, if bids are required generate a separate WBS Activity for the bidding process. Put items that require bids on separate purchase orders from those that don't.

## **3.4 Breakdown of Task Phases into Multiple WBS Activities**

Most tasks or subtasks, whether they are detector construction, mechanical supports, electrical or electronic, *etc.* in nature, have similar phases. The phases given below are typical:

- 1) Requirements and Preliminary Specifications Documents
- 2) Prototype Design
  - a) Procure
  - b) Fabricate
  - c) Assemble
  - d) Test
  - e) Document updates
- 3) Pre-production and production
  - a) Procure
  - b) Fabricate
  - c) Assemble
  - d) Test
- 4) System Tests
- 5) Transportation and Installation at C0
- 6) Final Documentation
- 7) (System) Checkout & Commissioning
- 8) Operation Documentation

Each phase of a task or subtask should be broken down into several short-duration (two to three months maximum) WBS Activities. The task-oriented WBS example in Section 5 illustrates both the breakdown of a typical subtask's prototype phase into short-duration WBS Activities and the level of detail that should be included within a single task or subtask phase.

Break each phase of a task or subtask into several, short-duration WBS Activities.

### 3.5 WBS Activities and Task Testing

Testing WBS Activities within a task or subtask should also be broken down into multiple WBS Activities. As an example, the prototype testing of electronics should be divided into several testing phases and thus several WBS Activities. One WBS Activity may test the first board alone. Two other WBS Activities may test a small number of boards together (looking for interactions between boards) and a large number together (more interaction testing). Other separate WBS Activities might be elevated/reduced temperature tests, power supply variation tests, long-term drift tests, *etc.* Another testing item generating additional WBS Activities is incoming testing for items produced either commercially or by another institution for use in the experiment. Incoming testing generally needs to be coordinated with the parts delivery schedule. Lastly, there should be additional WBS Activities for installation testing.

Break the testing activities of each phase of a task or subtask into multiple WBS Activities.

### 3.6 Multiple Institutions doing Similar or Identical Tasks

Every institution must have its own set of WBS Activity items. Where more than one institution is sharing the work on a particular part of the detector, each institution's WBS Activities should be identical or similar, at the same level, and only differ by WBS numbers and the subtask top WBS Activity description. The following example illustrates the correct implementation of WBS Activities for the two-university operation of constructing Muon photo multiplier tubes. In this example, the University A orders the photo multiplier tubes and the vendor delivers them to both universities.

#### Example 2.7: Multiple Institutions with Similar or Identical Tasks

- |             |  |
|-------------|--|
| 1.4.1.6     | <b>Construct Muon Photo Multiplier Tubes at the University A</b> |
| 1.4.1.6.1   | ...  |
| 1.4.1.6.2   | Order photo multiplier tubes                                     |
| 1.4.1.6.3   | Vendor delivery of photo multiplier tubes to Univ. of A          |
| 1.4.1.6.4   | Inspect incoming photo multiplier tubes                          |
| 1.4.1.6.4.1 | Temperature cycle photo multiplier tubes                         |
| 1.4.1.6.4.2 | Check photo multiplier tubes against specifications              |
| 1.4.1.6.5   | Clean photo multiplier tubes                                     |
| 1.4.1.6.6   | Glue photo multiplier tubes to frame                             |
| 1.4.1.6.7   | <i>Etc.</i>  |
| 1.4.1.7     | <b>Construct Muon Photo Multiplier Tubes at the University B</b> |
| 1.4.1.7.1   | ...  |
| 1.4.1.7.2   | Vendor delivery of photo multiplier tubes to Univ. of B          |
| 1.4.1.7.3   | Inspect incoming photo multiplier tubes                          |
| 1.4.1.7.3.1 | Temperature cycle photo multiplier tubes                         |
| 1.4.1.7.3.2 | Check photo multiplier tubes against specifications              |
| 1.4.1.7.4   | Clean photo multiplier tubes                                     |
| 1.4.1.7.5   | Glue photo multiplier tubes to frame                             |
| 1.4.1.7.6   | <i>Etc.</i>  |

In this example, the WBS Activities of both tasks are the same except for the ordering of the photo multiplier tubes. If necessary, the Level 4 and below WBS Activities could be identical. For example, the University A could order one third and the University B two thirds of the photo multiplier tubes. In this case the "Order photo multiplier tubes" would be in both WBS Activities 1.4.1.6 and 1.4.1.7. All Level 4 and below WBS Activity descriptions would then be identical in both 1.4.1.6 and 1.4.1.7.

Each institution must have its own set of WBS Activity items. This is true even in the case of very similar or identical work being done at different institutions.

### 3.7 *Costs for WBS Activities Done by Non-Fermilab Collaborators*

Work on WBS Activities by BTeV collaborators from institutions other than Fermilab will be costed differently from that done by BTeV collaborators and other personnel from Fermilab. Fixed-price costing will be used for all non-Fermilab personnel and material. Although fixed-price costing will be used for a collaborators WBS Activity, they will still be requested to enter personnel time in working days for each personnel classification (e.g., physicist, engineer, etc.) performing work on each WBS Activity along with material costs, etc. See Section 6 for further details.

Work on WBS Activities done by BTeV collaborators from institutions other than Fermilab will be costed using fixed-price costing.

Even though fixed-priced costing is used, personnel time for each personnel classification doing this work should be entered into the cost and schedule database, as should be material costs, schedule information, etc.

Payments on the contract will be based on the work completed and the material ordered.

### 3.8 *WBS Activities: Milestones*

Milestones can and should be WBS Activities. A milestone has no cost or personnel time associated with it. It simply functions as a marker of a significant achievement in a task's progress.

There shall be four levels of milestones. These four milestones shall be as defined below:

- **Level 0 Milestones:** (to be determined; see note below)
- **Level 1 Milestones:** Changeable by the BTeV Project Manager
- **Level 2 Milestones:** Changeable by Level 2 Managers only if the milestones are within the Manager's Level 2 Task and only if the milestone change does not effect any WBS Activities outside of that Manager's Level 2 Task. The Project Manager must approve the change if the milestone has effects on other WBS Activities outside of that Manager's Level 2 Task.
- **Level 3 Milestones:** Changeable by Level 3 Leaders only if the milestones are within the Leader's Level 3 Tasks and only if the milestone change does not effect any WBS Activities outside of that Leader's Level 3 Task. The corresponding Level 2 Manager and the Project Manager must approve the change if the milestone has effects on other WBS Activities outside of that Leader's Level 3 Task.

Managers and Leaders should incorporate Level 2 and Level 3 milestones, respectively, into their WBS Activities where appropriate. Level 0 and Level 1 milestones will be incorporated into the overall BTeV WBS by various levels of Fermilab, DOE and BTeV management.

The task-oriented WBS example in Section 5 illustrates milestones as part of a WBS.

Managers and Leaders should add Level 2 and Level 3 milestones to WBS Activities as markers of significant achievement in a task's or subtask's progress.

Note: BTeV's official change/approval process will be determined when DOE approves its *Project Execution Plan*. BTeV will make a proposal to DOE regarding thresholds for allowed WBS changes without DOE approval. When BTeV's *Project Execution Plan* is approved, the procedures will be published. For now the milestones only have the BTeV internal change/approval process listed above.

### 3.9 *WBS Activities: Reviews and Levels of Reviews*

BTeV is very important to Fermilab's future and is a very large project. As such, reviews of the status of the overall BTeV project and tasks and/or subtasks within the BTeV project will be requested and/or organized by various levels of management including DOE, Fermilab's Directorate, BTeV's Project

Manager, and other members of BTeV's Project Management team. In addition, Managers and Level N Leaders should conduct reviews of the status of their tasks and subtasks, respectively. They should also conduct reviews, with other Managers and Leaders, of the integration of their tasks and subtasks with other tasks and subtasks.

The importance of reviews should not be underestimated. Large amounts of personnel time and costs to the experiment will, in almost all cases, be saved and the task or subtask's schedule maintained if there are a significant amount of detailed, thorough reviews of their status during development, manufacturing, and installation and commissioning phases.

Using an electronics task for example purposes, suggested reviews should include:

- Review of a task's *Requirements* document
- Review of a task's *Preliminary Specifications* document
- Review of a task's integration with another task or subtask
- Review of a task's design and design simulations
- Review of a task's prototype testing specifications
- Review of a task's prototype tests
- *Etc.*
- Review of a task's personnel and equipment safety procedures
- Review of a task's installation and commissioning plans
- *Etc*

To ensure that the task or subtask is being integrated into the overall BTeV system correctly, reviews will be organized by BTeV Management. Reviews teams will include personnel responsible for tasks or subtasks that are affected in any way by the task or subtask being reviewed. Affected tasks and subtasks include, but are not limited to:

- Tasks or subtasks that interface mechanically (*e.g.*, support structures) and/or electrically to the task or subtask being reviewed
- Embedded software and/or firmware tasks whose code will reside in the task or task being reviewed
- Development, test and/or system software tasks used to control, monitor and/or readout the task or task being reviewed
- Support system tasks (*e.g.*, gas systems, cooling systems, high-voltage systems, *etc.*) that are needed to operate the task or task being reviewed

At every significant step of a task or subtask, include detailed and thorough reviews of its status as WBS Activities.

There is one level (or type) of review for each different milestone level (see Section 3.8). Thus, there are the following levels of reviews:

- **Level 0a Reviews:** Requested by the Department Of Energy (DOE), Washington
- **Level 0b Reviews:** Requested by the Department Of Energy, local office
- **Level 0c Reviews:** Requested by the Fermilab Director or members of the Fermilab Directorate
- **Level 1 Reviews:** Organized by the BTeV Project Manager or members of the BTeV Project Management team
- **Level 2 Reviews:** Organized by Task Managers of Level 2 WBS Activities and only if the Level 2 Manager's tasks are being reviewed
- **Level 3 Reviews:** Organized by Task Leaders of Level 3 WBS Activities and only if the Level 3 Leader's tasks are being reviewed

### ***3.10 WBS Activity Description Field Length***

This is the description of the WBS Activity (task). The length of this description is limited to 255 characters.

Although the WBS Activity Description field length can be large, it is recommended that it be kept small whenever practical. Doing this simplifies monitoring and report generation of WBS Activities.

Note: The information in this subsection will be moved to Section 6 before cost and schedule information is added to BTeV's WBS.

## **4 When WBS Activities become Task-Oriented (Verb-Based)**

At higher WBS Activity levels, cost and scheduling information has not be entered into the cost and schedule database. Cost and schedule information at these higher levels is attained by ‘rolling up’ information from lower-level WBS Activities. Cost and schedule information is usually entered the lowest WBS level of a given WBS Activity, sometimes also at the next higher levels. It is at these lowest WBS levels, where cost and schedule information is entered, that the WBS Activity descriptions must become task-oriented or verb-based. Up to this point the WBS Activity descriptions are mostly noun-based but could be verb-based if desired. The WBS example given in Section 5 illustrates how WBS Activities are named. This example includes task-oriented or verb-based WBS Activities at WBS levels in addition to the lowest levels.

Every WBS Activity that includes cost and schedule database information must have a task-oriented (verb-based) name. These WBS Activities are usually the lowest-level WBS Activities. Higher-level WBS Activities not including cost and schedule database information may also be task-oriented.

## 5 Task-Oriented WBS Example

The following is a detailed example of a task-oriented WBS for the prototyping phase of an electronics task. It is given here to illustrate the Section 3 guidelines for generating a task-oriented WBS. Note the level of detail, and the WBS Activities for documents, reviews and milestones and the separate WBS Activities for ordering and delivery of long and short-delivery components. The Level 2 reviews included are for example purposes only but represent the number and types of reviews recommended by BTeV Management. These reviews could also have been Level 3 reviews. The number and types of Level 2 and Level 3 are at the discretion of the Managers and Leaders, respectively.

Having WBS Activities structured as shown below will help implementers, their Level 2 Managers, Leaders, and the BTeV Project Manager. It will also help other members of the BTeV Management team, BTeV cost and schedule people, and other levels of management to better track the technical and cost status of the task or subtask.

- 1.9.1.1.3 **Buffer Memory Modules (BMMs)**
- 1.9.1.1.3.1 **BMM Development and Prototype Units**
- 1.9.1.1.3.1.1 Write Buffer Memory Module section of Level 2 Task *Requirements* Document
- 1.9.1.1.3.1.2 Write Buffer Memory Module Firmware section of Level 2 Task *Requirements* Document
- 1.9.1.1.3.1.3 Level 3 Review: Review BMM sections of Level 2 Task *Requirements* Document
- 1.9.1.1.3.1.3.1 Perform Review of BMM sections of Level 2 Task *Requirements* Document
- 1.9.1.1.3.1.3.2 Modify BMM sections of Level 2 Task *Requirements* Document If Necessary
- 1.9.1.1.3.1.3.3 Re-Review BMM sections of Level 2 Task *Requirements* Document If Necessary
- 1.9.1.1.3.1.4 **Level 3 Milestone:** BMM sections of Level 2 Task *Requirements* Document Reviewed and Approved
- 1.9.1.1.3.1.5 Write *Buffer Memory Module Preliminary Specifications* Document
- 1.9.1.1.3.1.6 Write *Buffer Memory Module Firmware Preliminary Specifications* Document
- 1.9.1.1.3.1.7 Level 3 Review: Review BMM *Preliminary Specifications* Documents
- 1.9.1.1.3.1.7.1 Perform Review of BMM *Preliminary Specifications* Documents
- 1.9.1.1.3.1.7.2 Modify BMM sections of Level 2 Task *Requirements* Document If Necessary
- 1.9.1.1.3.1.7.3 Re-Review Modify BMM sections of Level 2 Task *Requirements* Document If Necessary
- 1.9.1.1.3.1.8 **Level 3 Milestone:** BMM *Preliminary Specifications* Documents Reviewed and Approved
- 1.9.1.1.3.1.9 Design Buffer Memory Module
- 1.9.1.1.3.1.9.1 Simulate Design Using VHDL
- 1.9.1.1.3.1.9.2 Convert VHDL Code to Gate-Level Design
- 1.9.1.1.3.1.10 Code Buffer Memory Module Firmware
- 1.9.1.1.3.1.11 Level 3 Review: Review BMM Design, Simulations and Firmware Code
- 1.9.1.1.3.1.11.1 Perform Review of BMM Design, Simulations and Firmware Code
- 1.9.1.1.3.1.11.2 Modify BMM Design If Necessary
- 1.9.1.1.3.1.11.3 Re-Work BMM Simulations If Necessary
- 1.9.1.1.3.1.11.4 Convert Re-Worked BMM VHDL Code to Gate-Level Design If Necessary
- 1.9.1.1.3.1.11.5 Modify BMM Firmware Code If Necessary
- 1.9.1.1.3.1.11.6 Re-Review BMM Design, Simulations and/or Firmware Code If Necessary
- 1.9.1.1.3.1.12 **Level 3 Milestone:** Design, Simulations and Firmware Code Reviewed and Approved
- 1.9.1.1.3.1.13 Layout BMM Printed Circuit Board
- 1.9.1.1.3.1.13.1 Generate Parts Library
- 1.9.1.1.3.1.13.2 Layout BMM Design
- 1.9.1.1.3.1.13.3 Simulate Layout and Back-Annotate
- 1.9.1.1.3.1.13.4 Level 3 Review: Review BMM Layout and Simulations
- 1.9.1.1.3.1.13.4.1 Perform Review of BMM Layout and Simulations
- 1.9.1.1.3.1.13.4.2 Re-Work Parts Library If Necessary
- 1.9.1.1.3.1.13.4.3 Re-Layout Portions of BMM If Necessary
- 1.9.1.1.3.1.13.4.4 Simulate Re-Layout If Necessary
- 1.9.1.1.3.1.13.4.5 Re-Review Layout and/or Simulations If Necessary
- 1.9.1.1.3.1.13.5 **Level 3 Milestone:** BMM Layout and Simulations Reviewed and Approved
- 1.9.1.1.3.1.14 Level 1 Review: Review BMM Documents, Design, Simulations and Layout

1.9.1.1.3.1.14.1	Perform Review of BMM Documents, Design, Simulations and Layout
1.9.1.1.3.1.14.2	Re-Work BMM Documents, Design, Simulations and/or Layout If Necessary
1.9.1.1.3.1.14.3	Re-Review Documents, Design, Simulations and/or Layout If Necessary
1.9.1.1.3.1.15	<b>Level 1 Milestone:</b> BMM Documents, Design, Simulations and Layout Reviewed and Approved; BMM Approved for the Manufacture of Prototype Units
1.9.1.1.3.1.16	Manufacture Prototype BMMs
1.9.1.1.3.1.16.1	Procure Long-Delivery BMM Components
1.9.1.1.3.1.16.1.1	Order Long-Delivery BMM Prototype Components
1.9.1.1.3.1.16.1.2	Deliver Long-Delivery BMM Prototype Components
1.9.1.1.3.1.16.2	Procure of Short-Delivery BMM Components
1.9.1.1.3.1.16.2.1	Order Short-Delivery BMM Prototype Components
1.9.1.1.3.1.16.2.2	Deliver Short-Delivery BMM Prototype Components
1.9.1.1.3.1.17	Write <i>Prototype BMM PC Board Manufacturing and Testing Specifications</i>
1.9.1.1.3.1.18	Write <i>Prototype BMM PC Module Assembly and Testing Specifications</i>
1.9.1.1.3.1.19	Write Prototype BMM Module Manufacture, Assembly and Testing Contract
1.9.1.1.3.1.20	Level 3 Review: Review Prototype BMM Module Mfg., Assembly and Testing Documents
1.9.1.1.3.1.20.1	Perform Review of Prototype BMM Module Mfg., Assembly and Testing Documents
1.9.1.1.3.1.20.2	Re-Write <i>BMM PC Board Manufacturing and Testing Specifications</i> If Necessary
1.9.1.1.3.1.20.3	Re-Write <i>BMM Module Assembly and Testing Specifications</i> If Necessary
1.9.1.1.3.1.20.4	Re-Write BMM Module Manufacture, Assembly and Testing Contract If Necessary
1.9.1.1.3.1.20.5	Re-Review Prototype BMM Module Manufacturing, and/or Assembly and Testing Documents If Necessary
1.9.1.1.3.1.21	<b>Level 3 Milestone:</b> Prototype BMM Manufacture, and Assembly and Testing Documents Approved; Prototype BMMs Approved for Manufacture, Assembly and Testing
1.9.1.1.3.1.22	Procure of Short-Delivery BMM Components
1.9.1.1.3.1.22.1	Order PC Board Manufacture, and Assembly and Testing of Prototype BMMs
1.9.1.1.3.1.22.2	Deliver Prototype BMMs
1.9.1.1.3.1.23	Write Single and Multiple BMM Test Procedures
1.9.1.1.3.1.24	Write BMM System Test Procedures
1.9.1.1.3.1.25	Level 3 Review: Review Single and Multiple BMM and BMM System Test Procedures
1.9.1.1.3.1.25.1	Perform Review of Single and Multiple BMM and BMM System Test Procedures
1.9.1.1.3.1.25.2	Re-Write Single and Multiple BMM Test Procedures If Necessary
1.9.1.1.3.1.25.3	Re-Write BMM System Test Procedures If Necessary
1.9.1.1.3.1.25.4	Re- Review Single and Multiple BMM and/or BMM System Test Procedures If Necessary
1.9.1.1.3.1.26	<b>Level 3 Milestone:</b> BMM Single, Multiple and System Test Procedures Approved; Initiate Prototype BMM Testing
1.9.1.1.3.1.27	Test Single Prototype BMM
1.9.1.1.3.1.27.1	Test Internal Hardware and Associated Firmware
1.9.1.1.3.1.27.2	Test I/O Hardware and Associated Firmware
1.9.1.1.3.1.27.3	Temperature Cycle BMM
1.9.1.1.3.1.28	Test Multiple Prototype BMMs for Interactions Between BMMs
1.9.1.1.3.1.28.1	Perform Temperature Cycling Tests
1.9.1.1.3.1.28.2	Perform Power Supply Variation Tests
1.9.1.1.3.1.28.3	Perform Long-Term Functionality Tests
1.9.1.1.3.1.29	System Test Prototype BMMs Connected to Other System Components
1.9.1.1.3.1.29.1	Perform Temperature Cycling Tests
1.9.1.1.3.1.29.2	Perform Power Supply Variation Tests
1.9.1.1.3.1.29.3	Perform Long-Term Functionality Tests
1.9.1.1.3.1.30	Level 2 Review: Review Prototype BMM Test Results
1.9.1.1.3.1.30.1	Perform Review of Prototype BMM Test Results
1.9.1.1.3.1.30.2	Re-Write Single and Multiple BMM Test Procedures If Necessary
1.9.1.1.3.1.30.3	Re-Write BMM System Test Procedures If Necessary
1.9.1.1.3.1.30.4	Re- Review Single and Multiple BMM and/or BMM System Test Procedures If Necessary
1.9.1.1.3.1.30.5	Re-Test Single Prototype BMM If Necessary
1.9.1.1.3.1.30.6	Re-Test Multiple Prototype BMMs for Interactions Between BMMs If Necessary
1.9.1.1.3.1.30.7	Re-System Test Prototype BMMs Connected to Other System Components If Necessary

- 1.9.1.1.3.1.31 **Level 2 Milestone:** Prototype BMM Design and Testing Approved
- 1.9.1.1.3.1.32 Level 1 Review: Review BMM Test Documents and Test Results
- 1.9.1.1.3.1.32.1 Perform Review of BMM Test Documents and Test Results
- 1.9.1.1.3.1.32.2 Re-Work BMM Test Documents and/or Test Results If Necessary
- 1.9.1.1.3.1.32.3 Re-Review BMM Test Documents and/or Test Results If Necessary
- 1.9.1.1.3.1.33 **Level 1 Milestone:** Prototype BMM Test Documents and Test Results Reviewed and Approved; BMM Approved for the Manufacture of Pre-Production Units
- 1.9.1.1.3.2 **BMM Pre-Production and Production Units**
- 1.9.1.1.3.3 *Etc.*

## **6 Hardware & Software Support Issues**

WBS Activities that have to do with support issues should be included in the 'Task Management' section of Level 2 Task WBS Activities. For example, software that has been written for test stands that might have to be maintained is such an item. In this case, there would be a WBS Activity such as "Test Stand Software Support" under the appropriate WBS Level 2 Task's "Task Management" WBS Activity. The period over which the support is necessary can be of a long duration (not ~1-2 months as suggested elsewhere). Such a WBS Activity will be cost accounted linearly just as other management items. The time period must end no later than the end of the BTeV construction phase. Support after construction will be covered in operating budgets.

## **7 Required Information For Each WBS Activity**

This section will be completed at a later date. It will include guidelines for entering all the cost, schedule and other related items needed for each WBS Activity.
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